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<b>UTILITY PATENT APPLICATION TRANSMITTAL</b> <small>for new nonprovisional applications under 37 C.F.R. 1.53(b)</small>		Attorney Docket No. 1856/00018
		First Named Inventor or Application Identifier Thomas J. Mabry
Title	LOCKING DEVICE FOR MICROCHANNEL PLATE IN IMAGE AMPLIFIER TUBE	
Express Mail Label No		

**APPLICATION ELEMENTS**

1. ☒ Filing fee as calculated below.

2. ☒ Specification [Total Pages [12]]  
*(preferred arrangement set forth below)*

- Descriptive title of the invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the invention
- Brief Summary of the invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

Drawing(s) (35 USC 113) [Total Pages [7]]

Oath or Declaration [Total Pages [ ]]

a. ☐ Newly executed (original or copy)

b. ☐ Copy from a prior application (37 CFR 1.63(d))  
*(for continuation/divisional with Box 17 completed)*

DELETION OF INVENTOR(S)  
Signed statement attached deleting inventor(s)  
named in the prior application, see 37 CFR  
1.63(d)(2) and 1.33(b)

☐ Incorporation By Reference *(useable if Box 4b is checked)* The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

**ADDRESS TO:** Commissioner for Patents  
Box Applications  
Washington, D.C. 20231

6. ☐ Microfiche Computer Program *(Appendix)*

7. ☐ Nucleotide and/or Amino Acid Sequence  
Submission *(if applicable, all necessary)*

a. ☐ Computer readable copy

b. ☐ Paper Copy (identical to computer copy)

c. ☐ Statement Verifying identity of above  
copies

8. ☐ Assignment papers (cover sheet & document(s))

9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney

10. ☐ English Translation Document *(if applicable)*

11. ☒ Information Disclosure ☐ Copies of IDS  
Statement (IDS)/PTO-1449 2 Citations

12. ☐ Preliminary Amendment

13. ☒ Return Receipt Postcard (MPEP 503)  
*(Should be specifically itemized)*

14. ☐ Small Entity ☐ Statement filed in prior application,  
Statement(s) Status still proper and desired

15. ☐ Certified copy of Priority Document(s)  
*(if foreign priority is claimed)*

16. ☐ Other:

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:  
☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No. \_\_\_\_\_

**18. CORRESPONDENCE ADDRESS**

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		(Col 1)			(Col 2)	(Col 3)	SMALL ENTITY		OR	NON-SMALL ENTITY	
		NO. FILED				NO. EXTRA	RATE	FEE		RATE	FEE
TOTAL	11	minus	20	=	___		x9=	\$		x18=	\$0
INDEP	1	minus	3	=	___		x39=	\$		x78=	\$0
__ First Presentation, Multiple Dependent Claims							+130=	\$		+260=	\$0
Base Filing Fee								\$345			\$690
Other Fee (specify purpose)								\$			\$0
TOTAL FILING FEE* (accounting for possible small entity status)								\$	OR	TOTAL	\$690.00

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Name (Print/Type)	Martin Abramson	Registration No. (Attorney/Agent)	25,787
Signature		Date	8/17/2000

Variable	Mean	SD	Min	Max
Age	38.5	12.5	18	65
Gender	Male	100%		
Marital status	Married	100%		
Education	High school	100%		
Occupation	Teacher	100%		
Income	Low	100%		
Health status	Good	100%		
Smoking status	Non-smoker	100%		
Alcohol consumption	None	100%		
Stress level	Low	100%		
Sleep quality	Good	100%		
Dietary habits	Healthy	100%		
Exercise frequency	Regular	100%		
Family size	Small	100%		
Workload	Light	100%		
Compliance with treatment	High	100%		
Knowledge of disease	Good	100%		
Attitude towards treatment	Positive	100%		
Support system	Strong	100%		
Healthcare access	Easy	100%		
Insurance status	Insured	100%		
Transportation	Convenient	100%		
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Healthcare provider satisfaction	High	100%		
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Healthcare system reputation	High	100%		
Healthcare system standing	High	100%		
Healthcare system position	High	100%		
Healthcare system status	High	100%		
Healthcare system rank				

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# LOCKING DEVICE FOR MICROCHANNEL PLATE IN IMAGE AMPLIFIER TUBE

Patent Application

of

Thomas T. Mabry

[illegible]

### FIELD OF THE INVENTION

The present invention relates to image intensifier tubes and particularly to an improved device for locking a microchannel plate in a tube housing, which has the effect  
5 of shortening the length of the tube.

### BACKGROUND OF THE INVENTION

A night vision device amplifies the low levels of light which exist at night to the point where objects become  
10 visible to the human eye. The heart of the night vision device is the image intensifier tube, which along with suitable optics make up the night vision device.

The image intensifier tube is comprised of three active components, which are the photocathode, microchannel plate  
15 (MCP), and phosphor screen. The photocathode is a photoemissive wafer that is extremely sensitive to low radiation levels of light in the 580-590 nm spectral range.

When electromagnetic radiation impinges on the photocathode, the photocathode emits electrons in response.

20 The MCP is a relatively thin glass plate having input and output planes and an array of microscopic channels through it. An electron impinging on the MCP results in the emission of a number of secondary electrons which, in turn, cause the emission of more secondary electrons. Therefore,  
25 each microscopic channel acts as a channel type secondary emission electron multiplier having an electron gain of

approximately several hundred. The electron gain is primarily controlled by a potential difference between the input and output planes of the MCP. Consequently, the MCP increases the density of electron emission.

5       The anode includes an output fiber optic window and a phosphor screen which is formed on a surface of the window. Emitted electrons are accelerated towards the phosphor screen by maintaining the phosphor screen at a higher positive potential than the MCP. The phosphor screen  
10       converts the electron emission into an image which is visible to an operator. The tube body housing encompasses all three of the "active" tube elements so a vacuum envelope can be maintained.

As with most electronic devices, it is desired for the  
15       image intensifier to be as small as possible. The standard tube sizes presently have diameters of 18 mm and 25 mm. The desired miniaturization would be in the form decreasing the diameter, length, and weight of the image intensifier tube. The active tube components that can be shortened in length  
20       and diameter to any measurable degree would be the photocathode and the phosphor screen. The MCP can be changed in diameter but the length change would be at an absolute minimum.

A problem associated with the present design of image  
25       intensifier tubes is that the known methods for holding or locking the MCP in the tube housing add length and diameter

to the tube. That is, the fill factor (active components in proportion to support components) is very poor. The two main prior art methods of locking the MCP in the tube housing are described below in connection with Figure 1 and 2.

It is thus an object of the present invention to provide an image intensifier tube having a device for locking the MCP which does not add length to the tube and reduces the diameter.

In accordance with an aspect of the invention, this object is accomplished by providing an image intensifier tube comprising a tube housing which holds a photocathode and a screen, wherein a collar is provided which retains an MCP in a recess in an interior surface of the collar.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

The invention will be better understood by referring to the accompanying drawing, wherein:

Figure 1 shows an example of a prior art MCP locking device using a fixed washer and a springy washer.

Figure 2 shows an example of a prior art MCP locking device using a snap ring.

Figure 3 is a free body diagram for an inserted MCP in the prior art.

Figure 4 shows an embodiment of the collar of the present invention in which the MCP is inserted.

Figure 5 shows the collar mounted on a peripheral collar retention member.

5        Figure 6 is free body diagram for an inserted MCP in accordance with the present invention.

Figure 7 shows the structure of Figure 4 as mounted in a tube housing.

10

#### DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 shows an image intensifier tube which utilizes a prior art mode of mounting a MCP. Referring to the Figure, the active components of the device are a photocathode (not shown) which fits into receptacle 4, MCP  
15    6, and phosphor screen 8, which feeds visible light into fiber optic 10.

In this prior art mode, the MCP is locked by the combination of a rigid washer and a springy washer. The plate is supported on the bottom by annularly shaped lower  
20    MCP support 12 (shown in section) and is locked by the combination of rigid washer 14 which is retained between the MCP and the lower surface of upper MCP support 16, and springy washer 18, which is held under annular tabs 20 of the upper MCP support for creating a downward force.

25        As can be seen, the prior art washer arrangement adds length to the image intensifier tube.

Figure 2 shows an alternative prior art locking scheme, wherein like parts to these of Figure 1 are identified with primed numbers. In this mode, "snap ring" 22 is compression fit between upper MCP support 16' and the MCP. As can be  
5 seen, the snap ring also adds length to the image intensifier tube.

Figure 3 is a free body Force diagram for an inserted MCP corresponding to Figures 1 and 2. It will be seen that there are downwardly directed forces bearing on the top of  
10 the MCP.

Figure 4 depicts an embodiment of the annular collar 30 of the present invention. For ease of illustration, only half of the entire collar is shown in perspective.

The collar 30 is metallic, and is comprised of  
15 cylindrical member 32 and annular base 36. The interior surface 33 of cylindrical member 32 has a recess 34 in which the MCP is held. While the collar base 36 is continuous, cylindrical member 32 has a slice or gap in it, which can extend from the base to the top. The purpose of the slice  
20 or gap is to make the collar expandable when pressure is applied, to facilitate the insertion of the MCP in the recess 34.

Figure 5 shows how the collar is secured to peripheral retention member 40, while also showing the MCP 38 as  
25 retained in the collar 32.



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Figure 6 is a free body force diagram for an inserted MCP according to the present invention. When compared to Figure 3, it will be noted that in Figure 6 there are upwardly directed forces on the MCP, but no downwardly directed forces.

Peripheral retention member 40 is metallic, and it is comprised of annular platform 42, cylindrical member 44, and annular flange 46. The base 36 of the collar is correctly positioned on platform 42, and is secured thereto. Base 36 has holes 48, and the securing may be effected by welding the pieces together, where the welds are made in holes 48, thus fusing the two pieces. Alternatively, platform 42 may be provided with metallic tabs, which would extend through holes 48 and be bent over the base 36 to secure the two pieces together. In either case, since electrical contact is made between the collar and the peripheral retention means, a voltage for the MCP may be introduced via the part 41 of the peripheral retention means (Figure 7). An advantage of the invention is a reduced rate of electrical evaporation, since contact is made on the periphery and not on the top.

Figure 5 also shows MCP output contact support member 50,52,54, which supports the bottom of the MCP on surface 50 as well as ceramic ring 56. It is noted that while the components contact each other, for clarity of illustration, they are shown slightly separated.

Figure 7 shows an image intensifier tube assembly which incorporates the invention. The tube assembly includes as the active components cathode 60, MCP 38, and screen 61 which is deposited on the top surface of fiber optic 62.

5 The MCP is retained in the aforementioned recess in collar 32, while the base of the collar is secured to member 42 by welding or mechanical means. The MCP is also supported by MCP output contact support member 52,54, which has top support surface 50. This part also serves as a return path  
10 for current which passes through the MCP as a result of the potential difference across it. The metallic parts 40 and 54 are separated by ceramic ring 56 and the ceramic and metallic parts are brazed together, e.g., with a copper braze.

15 It will thus be appreciated that with the improved structure of the invention, no increase in the length of the tube is necessary for the securing of the MCP, and the diameter is also reduced. Additionally, there is a decrease in the number of body braze parts which are required.

20 The invention may be used in connection with the tube disclosed in U.S. Patent No. 6,040,657 which has a thin photocathode, to provide a system having a shorter tube profile and smaller diameter. However, in general, the invention may be utilized in any type of image intensifier  
25 tube.

While the invention has been described in connection  
with an illustrative embodiment, variations which occur to  
those in the art are also encompassed herein, and the  
invention is defined in the claims which are appended  
5 hereto.

What is claimed is:

1. An image intensifier tube comprising a housing which holds a photocathode and a screen, wherein a microchannel plate is supported in a recess in an interior surface of a collar which is also held in the housing.

2. The image intensifier of claim 1 wherein the collar is comprised of an annularly shaped base and a first cylindrical member disposed perpendicular to the base having interior and exterior surfaces, wherein the recess for holding the microchannel plate is in the interior surface of the cylindrical member.

3. The image intensifier of claim 3 wherein the recess is near the end of the cylindrical member away from the base.

4. The image intensifier of claim 2 wherein the collar is supported in the housing by at least a peripheral retention member.

5. The image intensifier of claim 4 wherein the peripheral retention member has,

a platform on which the base of the collar is secured,

a second cylindrical member which is perpendicular to the platform and concentric with the first cylindrical member of the collar and

an annular flange at the end of the second cylindrical member which extends in a direction away from the platform.

6. The image intensifier of claim 5 wherein the peripheral retention member is secured to the tube housing by the annular flange.

7. The image intensifier of claim 5 wherein the base of the collar is welded to the platform of the peripheral retention member.

8. The image intensifier of claim 5 wherein the base of the collar is secured to the platform of the peripheral retention member by locking tabs.

9. The image intensifier of claim 4 wherein the collar is further supported in the housing by an output contact support member located near the periphery of the microchannel plate on which the bottom of the microchannel plate rests.

10. The image intensifier of claim 9 wherein the output contact support member has a first surface parallel to the

microchannel plate on which the bottom of the microchannel plate rests, a second portion perpendicular to the first surface which extends in a direction away from the microchannel plate, and a third portion parallel to the first surface which extends towards the outside of the tube.

11. The image intensifier of claim 10 wherein there is a ceramic ring between the flange of the peripheral retention member and the third portion of the output contact support member, which forms part of the tube housing.

# ABSTRACT OF THE DISCLOSURE

An image intensifier tube comprising a housing which holds a photocathode and a screen, wherein a microchannel plate is supported in a recess in an interior surface of an annular collar which is also held in the housing.

008180" 5894960





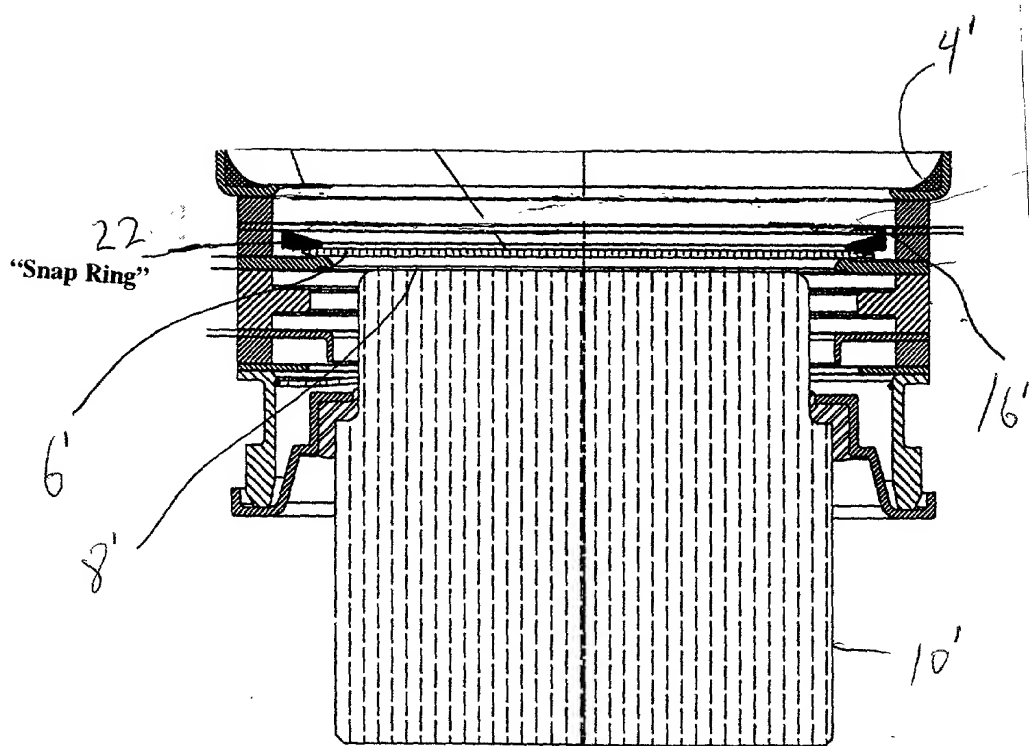


Figure 2

Image Intensifier Tube (with "snap ring")

008720" SEP 4 1960

FREE - BODY DIAGRAM FOR  
INSERTED MCP (PRIOR ART)

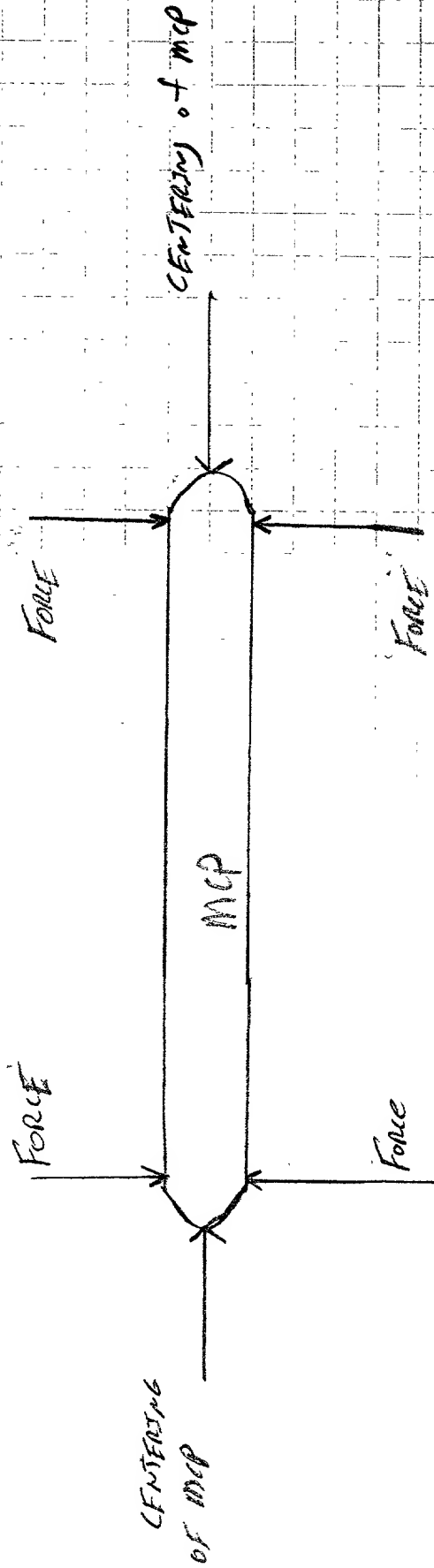


FIGURE 3

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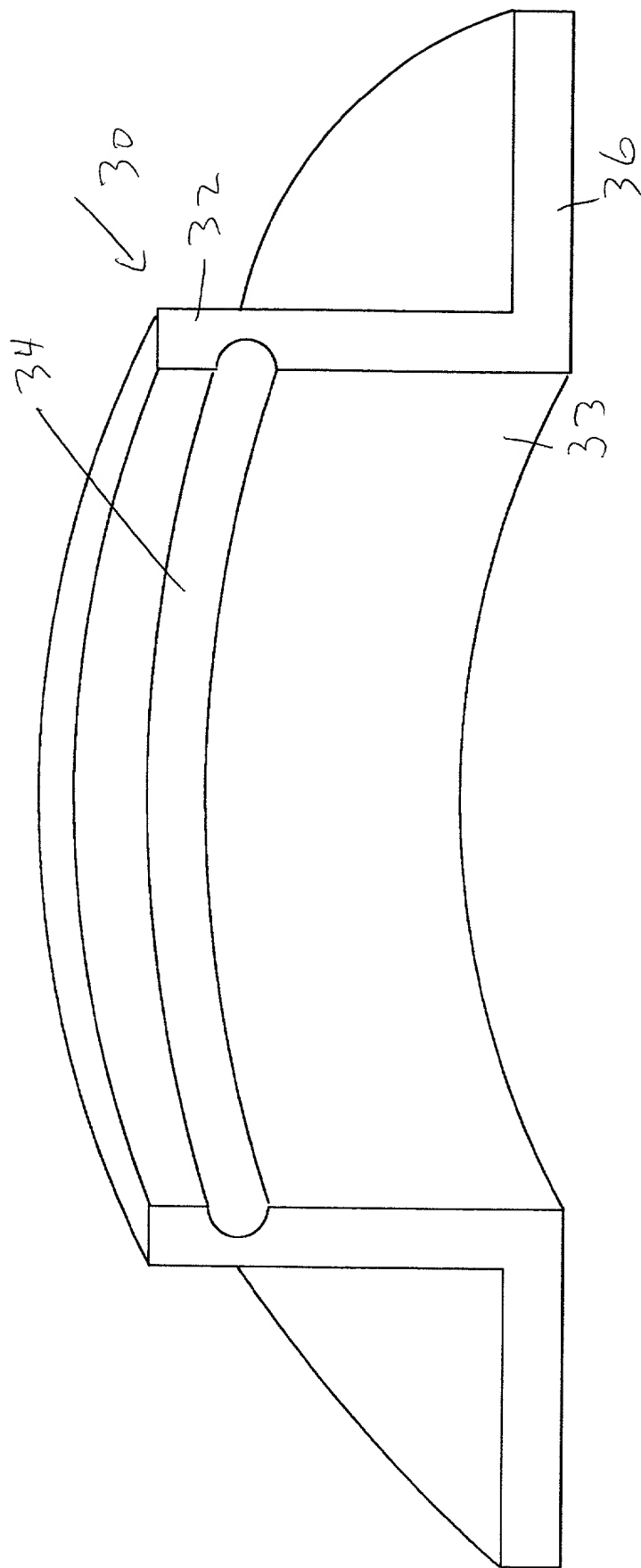


Figure 4

Weldable Collar

008T80" 589T4960

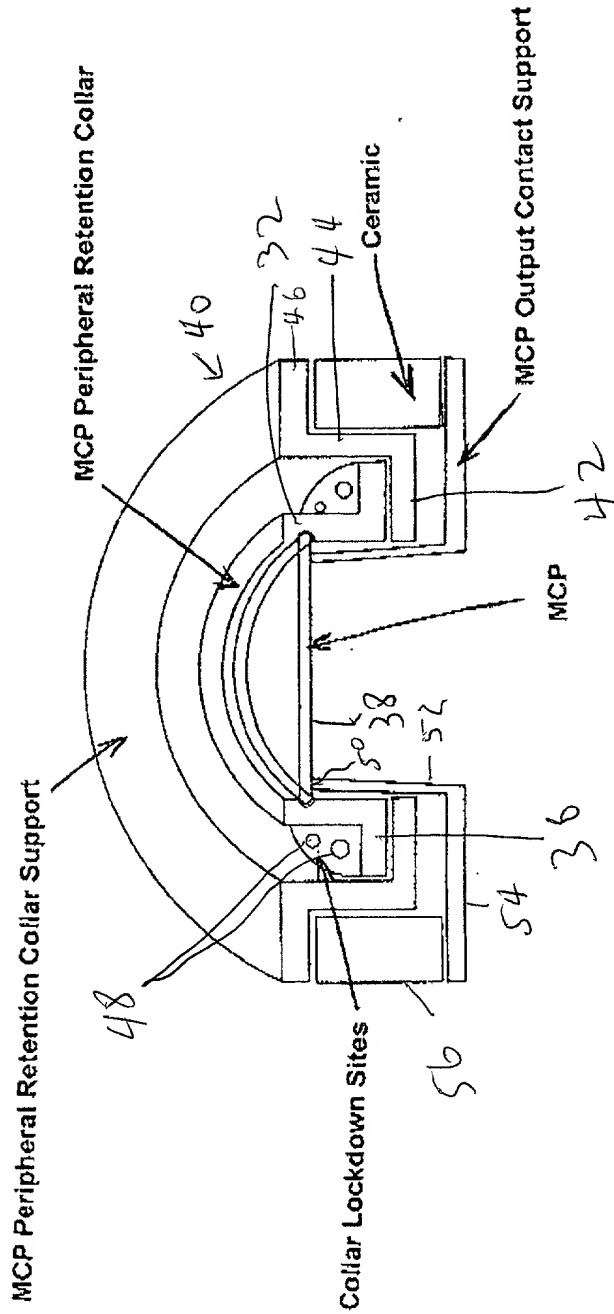


Figure 5

# FREE BODY DIAGRAM FOR PERIPHERAL MOUNTED MCP

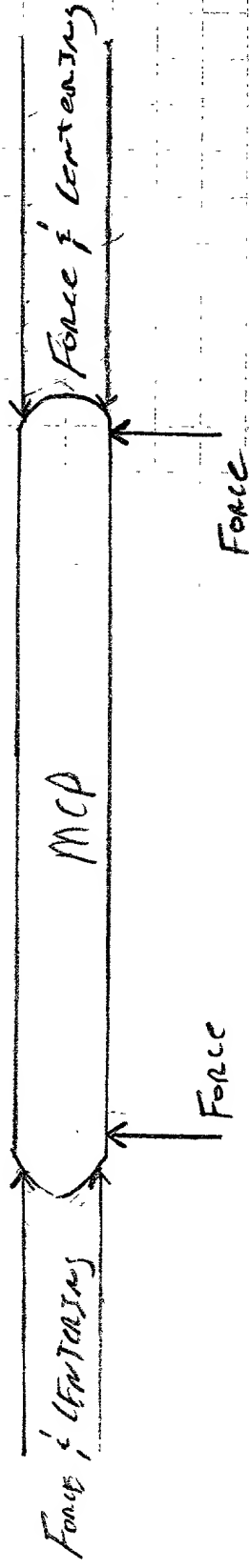


FIGURE 6

DRAWN BY T. MABINE JTC-NO  
6/29/00

